The question of the glacial origin of lakes involves many separate considerations. While lakes undoubtedly abound in regions now or formerly subjected to glaciation, many of these are formed by the damming of valleys by moraine heaps, or by extensive landslips. The school of Sir A. Ramsay affirm that glaciers are powerful excavating agents, and that there is no other agent but ice competent to form a rock-basin. The last argument breaks down when one considers the number of depressions of all sizes gradually increasing from mere volcanic craters to those of the Jordan Valley and the Caspian Sea, in the formation of which ice could have had no part. The argument that Greenland alone holds the key to the phenomena of glaciation breaks down, for the Alps were once the seat of a vast ice-sheet, which over-rode all the minor inequalities of the surrounding country, and of which the existing glaciers are the shrunken remnant. Thus the Alpine valleys should serve to show the typical results of ice-action on the land. This is the sum of their evidence: toothed prominences have been broken or rubbed away, the rough places have been made smooth, the rugged hill has been reduced to rounded slopes of rock (like the backs of plunging dolphins). But the crag remains a crag, the buttress a buttress, and the hill a hill; the valley also does not alter its leading outlines, the V-like section so characteristic of ordinary fluviatile erosion still remains; all that the ice has done has been to act like a gigantic rasp; it has modified, not revolutionised, it has moulded, not regenerated. No sooner do we come to study in detail the effects of the ancient glaciers in the upper valleys of the Alps than we are struck by their apparent inefficiency as erosive agents. Here, where the ice has lingered longest, just beneath the actual glacier we see that a cliff continues to exist. Again and again in a valley we may find that on the lee side of prominences crags still remain, sometimes in sufficient frequency to be marked features in the scenery. The Haslithal is an excellent and representative example. The result of prolonged personal study of the Alps may be summed up in the words—"Valleys appear to be much older than the Ice Age, and to have been but little modified during the period of maximum extension of the glaciers."

The evidence as to the erosive power of glaciers is very slight. Dr. Wright showed that the great Muir Glacier in Alaska covers great stretches of undisturbed gravel in which upright tree-stems remain. Prof. Bonney proceeded to say:—In the Alps about the year 1860 the glaciers began to dwindle. By 1870 considerable tracts of bare rock or debris were exposed, which a dozen years before had been buried under the ice. On none of these have I seen any basin-like hollow or sign of excavation as distinguished from abrasion. The Unter Grindelwald Glacier in the last stage of its descent passes over three or four rocky terraces. The angles of these are not very seriously worn away, nor are hollows excavated at the base of the steps. The bed of the Argentière Glacier (I made my way some little distance under the ice) was rather unequal, and was less uniformly abraded than I had expected. There were no signs whatever of the glacier being able to break off or root up blocks of the subjacent schistose rock: it seemed simply to wear away prominences. This also is true of other glaciers. Prior to 1860, and again in 1891, I saw glaciers which were advancing. They ploughed up the turf of a meadow for a foot or two in depth; they pushed moraine-stuff in front of them, showing some tendency to over-ride it, and nothing more. In 1875, at the foot both of the Glacier des Bois and of the Argentière Glacier, was a stony plain. Both these proved to have been recently uncovered by the ice; in other words, the glacier had not been able to plough up a boulder-bed even at a place where, owing to the change of level, some erosive action not unreasonably might have been expected. But, further, on both these plains big blocks of protogine were lying which were striated on sides and top, thus showing that the ice had actually flowed over them, as if it were a stream of mud. Some of the difficulties in the way of believing in the scooping out of lake-basins have now to be considered.

First, in regard to their position: some of them, such as Constance, Geneva, Como, Maggiore, &c., are comparatively near to the lower limits of the great ice sheets, and so would be covered for a relatively short time. All of them are many miles from the ends of the existing glaciers, yet we are asked to admit that a rock basin, in depth sometimes exceeding 1000 feet and generally more than 500, has been scooped out in a time much shorter than that which has proved insufficient for the obliteration of the original features of the upper valleys or for the deepening of their beds by more than a few yards at most—indeed, as a rule, the ice seems never to have been able to overtake the torrent.

The radiating arms of the Lakes of Lucerne, Lugano, and Como are insuperable difficulties in the way of accepting a glacial theory of the origin of these lakes, and the configuration of the Lake of Geneva and the other lakes in France recently minutely surveyed, lends no countenance to the theory of excavation.

One fact to which Prof. J. Geikie has called attention seems at first sight strongly to support Sir A. Ramsay's hypothesis, and is the only real addition, in my opinion, which has been made to the original reasons. It is that many of the Scottish lochs are true rock basins, and that similar basins frequently occur outside their mouths. This also often holds of the fjords in Norway, New Zealand, and elsewhere. Prof. Geikie points out that several of these basins occur just when the ice might be expected to obtain an increased scooping power. His map at first sight appears very convincing; but a study of the larger charts reveals many anomalies. Loch Linnhe, for example, from below the entry of Loch Leven, maintains a general depth of from 34 to 50 fathoms; then, below Loch Corrie, a channel may be traced which varies in depth from 50 to 60 fathoms, after which, in the Lynn of Morven, we find it deepen to 70 fathoms, then to 90 fathoms; and at last, a little north-east of the line joining Barony Point with Lismore Point, it expands into a basin with a maximum depth of 110 fathoms. But outside, in the Sound of Mull (to the north-west) the depths become very irregular, varying from about 35 to 70 fathoms. Barony Point appears to be connected with Mull by a submerged isthmus, generally less than 20 fathoms below the surface. But here, if the glacier were stopped by impinging on Mull, it ought in splitting to be pushing hard upon its bed. In all this region the irregularities of the bed are very perplexing, whatever hypothesis be adopted; but I will restrict myself to a single instance. Off the west coast of Scarba, under the lee of the "Islands of the Sea," and where the opening towards Colonsay makes it improbable that the ice can have forced into a narrower space, an elongated basin occurs in which the soundings—outside about 60 fathoms—deepen to 100, and at one place to 137 fathoms. The sea-bed about Arran presents similar difficulties. In short, here, at Loch Etive, Loch Lomond, and in other places, all goes well only so long as we restrict ourselves to generalities and abstain from details.

The theory of the origin of rock-basins, which I brought forward full twenty years ago, is now supported by much additional evidence. It is that the lake beds are ordinary valleys of sub-aerial erosion, affected by differential earth-movements. This has been very strongly confirmed by the surveys of the old beaches of the great lakes of North America, the Iroquois beach being full 600 feet higher at the north-eastern part than it is at the western end of Lake Ontario.

To conclude, glaciers, when the paths which they have traversed are carefully studied, appear to have acted, as a rule, as agents of the abrasion rather than of erosion. Even in the former capacity they have generally failed to obliterate the more marked pre-existent features due to ordinary fluviatile and sub-aerial sculpture. In the latter capacity they seem to have been impotent, except under very special circumstances; thus, while we may venture to ascribe to glaciers certain shallow tarns and rock basins in situations exceptionally favourable, we cannot assign to their agency either the greater Alpine lakes or any other important lakes in regions which were overflowed by the ice only during the period when it attained to an abnormal development. In the discussion which followed the paper, Dr. Blanford, Sir Henry Howorth, Mr. Freshfield, and Mr. Conway took part.

FURTHER STUDIES ON HYDRAZINE.

A FURTHER contribution to the chemistry of hydrazine, N_2H_4, is communicated by Prof. Curtius to the current number of the *Berichte*. The first portion of the memoir deals with the preparation and properties of substituted hydrazines containing the radicles of the organic acids. In the latter portion a number of inorganic salts containing hydrazine are described.

When hydrazine hydrate is brought in contact with the amides,

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chlorides, or esters of the organic acids, primary acid hydrazines are produced, of the general structure $R.CO.NH.NH_2$, where R represents the hydrocarbon radical contained in the acid Ammonia, hydrochloric acid, or alcohol is simultaneously formed, according as an amide, a chloride, or an ester is employed. The reactions proceed with facility and regularity, frequently in the cold, and afford theoretical yields of the substituted hydrazines. For many reasons, however, the esters are most convenient for the preparation of these acid hydrazines upon a large scale.

The primary acid hydrazines are colourless, non-volatile solids which usually crystallise well. The first member of the series, formyl hydrazine, $H.CO.NH.NH_2$, melts at 54°. They are usually soluble in water and alcohol, but insoluble in ether. Most of them form stable salts with one molecule of hydrochloric acid. The hydrogen of the imido group NH is replaceable by metallic sodium or by the radical acetyl. They possess reducing properties similar to those of phenyl-hydrazine, and they condense readily with aldehydes and ketones to form insoluble tertiary hydrazines. Upon heating, frequently by simply boiling their aqueous solutions, they become converted into secondary symmetrical hydrazines in accordance with the equation: $2R.CO.NH.NH_2 = R.CO.NH.NH.CO.R + N_2H_4$. The liberated hydrazine decomposes into ammonia and free nitrogen.

The secondary symmetrical acid hydrazines are very stable substances, soluble only to a slight extent in water. They are usually colourless, possess high melting points, and behave as acids. By the action of powerful oxidising agents they are converted into substances endowed with brilliant colours, ranging from yellow to bright red, which appear to be of the nature of "azo" compounds.

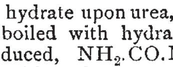
Of particular interest is the substituted hydrazine obtained by the action of hydrazine hydrate upon urea, the amide of carbonic acid. When urea is boiled with hydrazine hydrate a monohydrazide is first produced, $NH_2.CO.NH.NH_2$. This substance, however, is unstable and passes spontaneously into the secondary symmetrical compound $NH_2.CO.NH.NH.CO.NH_2$ with elimination of hydrazine, N_2H_4. This secondary hydrazide is identical with a compound of the same constitution previously obtained in an entirely different manner by Thiele.

An extremely interesting reaction occurs when the acidyl hydrazines of monobasic acids are treated with nitrous acid. They are directly converted into esters of azoimide, N_3H, in accordance with the following equation:—

$$R.CO.NH.NH_2 + NO.OH = R.CO.N_3 + 2H_2O.$$

During the course of work upon this latter reaction it was observed that the organic azoimides, both those containing acid and those containing hydrocarbon radicles, $R.CO.N_3$ and RN_3, behave in a peculiar manner with water. Thus diazobenzene-imide $C_6H_5.N_3$ resinises with a copious evolution of gas; similarly benzoylazoimide, $C_6H_5.CO.N_3$, when boiled for some time in contact with water evolves large quantities of nitrogen and carbon dioxide, and becomes converted into a magnificently crystallising base of the composition of a symmetrical diamidobenzophenone, $C_6H_4.NH_2.CO.NH_2.C_6H_4$.

The hydrazines of dibasic acids do not yield derivatives of azoimide, but break up with a violent evolution of nitrogen and formation of secondary symmetrical hydrazines. For instance the hydrazine of oxalic acid yields the symmetrical compound



$$\begin{array}{c} CO.NH.NH.CO \\ | \qquad\qquad | \\ CO.NH.NH.CO \end{array}$$

Several of the hydrazines of unsaturated acids behave in a manner peculiar to themselves. Thus the hydrazine derived from fumaric acid, $C_2H_2(CO.NH.NH_2)_2$, yields with nitrous acid an extremely explosive colourless compound, of the nature of a diazofumaramide, $C_2H_2(CO.NH.N_2.OH)_2$.

Prof. Curtius has succeeded in preparing a large number of double salts of metallic sulphates and chlorides with hydrazine sulphate and chloride. The double sulphates are constituted according to the general formula $(N_2H_4)_2H_2SO_4.R''SO_4$, and are distinguished by their difficult solubility and by the absence of water of crystallisation. Salts of the series have been prepared containing as the metal R″ copper, nickel, cobalt, iron, manganese, zinc, and cadmium; magnesium does not appear capable of forming a double sulphate. The blue copper salt is only soluble to the extent of one part in 1150 parts of water at 10°. It dissolves in ammonia with evolution of nitrogen.

The double chlorides are constituted according to the general formula $N_2H_4.HCl.RCl$. They are readily soluble in water, and certain of them may also be recrystallised from alcohol. Some contain water of crystallisation, while others are anhydrous and exhibit sharp melting points.

Hydrazine likewise forms a double phosphate with magnesium, which closely resembles ammonium magnesium phosphate.

Hydrazine appears to be remarkably stable towards nitric acid, but Prof. Curtius has eventually obtained the nitrate, $N_2H_4.HNO_3$, in splendid crystals which melt at 70°. If these crystals are heated suddenly they explode with great violence. The acid salt, $N_2H_4.2HNO_3$, loses nitric acid when its solution is evaporated. It may be remembered that Prof. Curtius observed a similar greater stability of the monacid salt in the case of the chlorides, for upon heating the dihydrochloride, $N_2H_4.2HCl$, to 140°, it was found to be completely converted into the monohydrochloride, $N_2H_4.HCl$.

A. E. TUTTON.

THE INTERNATIONAL CONGRESS OF PREHISTORIC ARCHÆOLOGY AND ANTHROPOLOGY.

IT is probably unique in the history of congresses that a report of the proceedings should be published within a period of three months from the time of the meeting. Such a feat was accomplished by the publication committee of the International Congress of Prehistoric Archæology and Anthropology, the eleventh session of which was held some time ago at Moscow. All the communications are printed in French. The first volume of the Report is divided into five sections; of these the first is devoted to geology and palæontology in their relations to primitive man. In his paper upon the constitution of the quaternary deposits in Russia and their relations to the finds resulting from the activity of prehistoric man, S. Nikitine draws the following conclusions:—The subdivision of the stone age into palæolithic and neolithic epochs should be retained for Russia in Europe, because it coincides with the geological subdivisions pleistocene and recent, which in their turn are based upon palæontological facts. The study of the glacial deposits of Finland and of the western region do not furnish any proof of the existence of two special glacial epochs and of an interglacial epoch; all the facts can be explained by phenomena of the oscillation of a glacier at the time of its gradual but irregular retreat. The time corresponding to the inter-glacial epoch and that of the second glaciation of the Swedes was probably for the greater part of Russia the period of the formation of ancient lacustrine deposits, of the loess and of the upper fluviatile terraces, containing the bones of the mammoth and other extinct mammals. Man lived simultaneously with the mammoth during the second half of the glacial epoch along the limit of glaciation, knowing amongst other things the use of fire, but only making splintered flint implements. As the glacier retreated man advanced towards the north and north-west; he arrived in Finland and in the Baltic region after the close of the glaciation, and after the disappearance of the mammoth; but man then possessed the more advanced culture of the neolithic period, and besides chipped flint implements he knew how to make implements of polished stone, pottery, &c. Russia in Europe does not present any traces of man in the first half of the pleistocene or of still more ancient man.—Prof. W. W. Dokoutchaïev contributes a valuable essay on the Russian steppes, past and present, in which he deals with the last page of Russian geology, and comes to the conclusion that before the glacial period the difference between the relative altitudes of the north-west and of the centre of Russia were much more considerable than at present. The author describes the carving of the steppes and their surface drainage; their soil, and that of the forests; the vegetation, fauna, and climate of the

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